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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P 20275 PC	FOR FURTHER ACTION See Form PCT/IPEA/416	
International application No. PCT/NO2003/000291	International filing date (day/month/year) 22.08.2003	Priority date (day/month/year) 26.08.2002
International Patent Classification (IPC) or national classification and IPC E21B 43/12, E21B 43/25		
Applicant Reslink AS et al		

- This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
- This REPORT consists of a total of 4 sheets, including this cover sheet.
- This report is also accompanied by ANNEXES, comprising:
 - ☒ (sent to the applicant and to the International Bureau) a total of 16 sheets, as follows:
 - ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
 - ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
 - ☐ (sent to the International Bureau only) a total of _____, containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

- This report contains indications relating to the following items:

- | | | |
|-------------------------------------|--------------|---|
| <input checked="" type="checkbox"/> | Box No. I | Basis of the report |
| <input type="checkbox"/> | Box No. II | Priority |
| <input type="checkbox"/> | Box No. III | Non-establishment of opinion with regard to novelty, inventive step and industrial applicability |
| <input type="checkbox"/> | Box No. IV | Lack of unity of invention |
| <input checked="" type="checkbox"/> | Box No. V | Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement |
| <input type="checkbox"/> | Box No. VI | Certain documents cited |
| <input type="checkbox"/> | Box No. VII | Certain defects in the international application |
| <input type="checkbox"/> | Box No. VIII | Certain observations on the international application |

Date of submission of the demand 20.11.2003	Date of completion of this report 22.11.2004
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. +46 8 667 72 88	Authorized officer Christer Bäcknert / MRO Telephone No. +46 8 782 25 00

Form PCT/IPEA/409 (cover sheet) (January 2004)

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/NO2003/000291

Box No. I Basis of the report

1. With regard to the language, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ This report is based on a translation from the original language into the following language _____, which is the language of a translation furnished for the purposes of:

- ☐ international search (under Rules 12.3 and 23.1(b))
☐ publication of the international application (under Rule 12.4)
☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the elements of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

☐ the international application as originally filed/furnished

☒ the description:

pages 1-20 as originally filed/furnished

pages* _____ received by this Authority on _____

pages* _____ received by this Authority on _____

☒ the claims:

pages _____ as originally filed/furnished

pages* _____ as amended (together with any statement) under Article 19

pages* 1-9 received by this Authority on 12.07.2004

pages* _____ received by this Authority on _____

☒ the drawings:

pages _____ as originally filed/furnished

pages* 1-7 received by this Authority on 12.07.2004

pages* _____ received by this Authority on _____

☐ a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages _____

☐ the claims, Nos. _____

☐ the drawings, sheets/figs _____

☐ the sequence listing (specify): _____

☐ any table(s) related to the sequence listing (specify): _____

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

☐ the description, pages _____

☐ the claims, Nos. _____

☐ the drawings, sheets/figs _____

☐ the sequence listing (specify): _____

☐ any table(s) related to the sequence listing (specify): _____

* If item 4 applies, some or all of those sheets may be marked "superseded."

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/NO2003/000291

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	<u>1-34</u>	YES
	Claims		NO
Inventive step (IS)	Claims	<u>1-34</u>	YES
	Claims		NO
Industrial applicability (IA)	Claims	<u>1-34</u>	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

Document cited in the International Search Report and considered to be of particular relevance:

D1: EP 0588421 A1

The invention relates to a well injection string for injection of a fluid into an underground formation. It is intended to solve the problem of a non-linear and increasing pressure loss progression along the injection string. According to the amended claims, the invention provides a solution where the injection string includes at least one fluid outflow zone provided with one or more through-going pipe wall openings in which at least one pressure-loss-promoting flow control device in the form of a flow restriction is provided and where said flow restriction is selected from the following types of flow restrictions: a nozzle, an orifice in the form of a slot or a hole; and a sealing plug.

The cited document discloses a pipe for production of oil or gas from a well where the pipe is provided with one or more inflow-restriction devices. Two embodiments of the inflow-restriction devices are disclosed: a thin pipe attached on the outside of the production pipe and a thickening in the form of a sleeve or gate equipped with one or more inflow channels and where the inflow is regulated by means of one or more screws or plugs devices.

The invention according to the claims is not disclosed by the cited document.

.../...

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: BOX V

The cited prior art does not give any indication that would lead a person skilled in the art to the claimed well injection string and method for controlling an injection fluid outflow rate. Therefore, the claimed invention is not obvious to a person skilled in the art.

Accordingly, the invention defined in claims 1-34 is novel and is considered to involve an inventive step.

The invention is also industrially applicable.

A m e n d e d c l a i m s

1. A well injection string (4) for injection of a fluid into
at least one reservoir (6) intersected by the string (4),
in which at least a part of the injection string (4) in-
cludes at least one fluid outflow zone provided with one
or more through-going pipe wall openings (28, 87) located
opposite the reservoir (6) when placed therein, and in
which at least one pressure-loss-promoting flow control
device in the form of a flow restriction is provided to
at least one of said pipe wall openings (28, 87) in the
injection string (4), the flow control device controlling
the injection fluid outflow rate therethrough and onwards
into the reservoir (6) when placed therein, c h a r -
a c t e r i z e d i n that said flow restriction is se-
lected from the following types of flow restrictions:

- a nozzle;
- an orifice in the form of a slot or a hole; and
- a sealing plug.

2. The well injection string (4) according to claim 1,
c h a r a c t e r i z e d i n that said flow restriction
is provided as a removable and replaceable insert (12).

3. The well injection string (4) according to claim 2,
c h a r a c t e r i z e d i n that the insert (12) is
disposed in an insert bore (28) in the pipe wall of the
string (4), the bore (28) comprising said pipe wall open-
ing in the injection string (4), whereby said outflow
zone may be provided with several insert bores (28), each
bore (28) containing a removable insert (12).

4. The well injection string (4) according to claim 2,
c h a r a c t e r i z e d i n that the insert (12) is
disposed in an axially through-going insert bore (32, 92)
in an annular collar (34, 90) disposed pressure-sealingly
around the injection string (4) so as to project out-
wardly therefrom; and wherein the collar (34, 90) also is
disposed pressure-sealingly against an external and re-
movable housing (36, 42, 86) pressure-sealingly enclosing
said at least one pipe wall opening (28, 87) in the in-
jection string (4), thereby providing a through-going
flow channel (38, 88) between the collar (34) and the at
least one pipe wall opening (28, 87), whereby the collar
(34, 90) may be provided with several insert bores (32,
92) around the circumference thereof, each bore (32, 92)
containing a removable insert (12).
5. The well injection string (4) according to claim 2, 3 or
4, c h a r a c t e r i z e d i n that an outflow zone
having two or more inserts (12) arranged thereto, is pro-
vided with a mixture of said types of flow restrictions.
6. The well injection string (4) according to any of claims
2-5, c h a r a c t e r i z e d i n that an outflow zone
arranged with two or more inserts (12) containing a noz-
zle or an orifice each, is provided with nozzles or ori-
fices of similar or dissimilar internal opening sizes.
7. The well injection string (4) according to any of claims
2-6, c h a r a c t e r i z e d i n that the inserts
(12) in the string (4) are of identical external size and
shape.

8. The well injection string (4) according to any of claims 4-7, characterized in that the downstream side of said housing (36, 42, 86) is extended axially and past said collar (34, 90), said extension of the housing (36, 42, 86) thereby forming a through-going and annular fluid collision chamber (48, 100) within which the injection fluid is subjected to a pressure-reducing energy loss.
9. The well injection string (4) according to claim 8, characterized in that a flow-through grid plate or perforated plate (50) of erosion-resistant material is disposed in said fluid collision chamber (48, 100).
10. The well injection string (4) according to any of claims 4-9, characterized in that the downstream side of the housing (36, 42, 54, 86) is connected to a sand screen (44, 98).
11. A method of controlling an injection fluid outflow rate from at least one fluid outflow zone of a well injection string (4) intersecting at least one reservoir (6), the at least one fluid outflow zone being provided with one or more through-going pipe wall openings (28, 87) located opposite the reservoir (6) when placed therein, said method being initiated by injecting said fluid from surface via the injection string (4) and then through at least one pressure-loss-promoting flow control device in the form of a flow restriction provided to at least one of said pipe wall openings (28, 87) in the injection string (4), after which the injection fluid flows onwards

into the surrounding reservoir (6), characterized in that the method further comprises selecting said flow restriction from the following types of flow restrictions:

- a nozzle;
- an orifice in the form of a slot or a hole; and
- a sealing plug.

12. The method according to claim 11, characterized in that the method further comprises:

- forming said flow restriction as a removable and replaceable insert (12).

13. The method according to claim 12, characterized in that the method further comprises:

- disposing the insert (12) in an insert bore (28) in the pipe wall of the string (4), the bore (28) comprising said pipe wall opening in the injection string (4), whereby said outflow zone may be provided with several insert bores (28), each bore (28) containing a removable insert (12).

14. The method according to claim 12, characterized in that the method further comprises:

- disposing the insert (12) in an axially through-going insert bore (32, 92) in an annular collar (34, 90) disposed pressure-sealingly around the injection string (4) so as to project outwardly therefrom, the collar (34, 90) also being disposed pressure-sealingly against an external and removable housing (36, 42, 86) pressure-sealingly enclosing said at least one pipe wall opening (28, 87) in the injection string (4), thereby providing a through-

going flow channel (38, 88) between the collar (34) and the at least one pipe wall opening (28, 87), whereby the collar (34, 90) may be provided with several insert bores (32, 92) around the circumference thereof, and a removable insert (12) being disposed in each bore (32, 92).

15. The method according to claim 12, 13 or 14, characterized in that the method further comprises:
- providing an outflow zone having two or more inserts (12) arranged thereto, with a mixture of said types of flow restrictions.

16. The method according to any of claims 12-15, characterized in that the method further comprises:
- providing an outflow zone having two or more inserts (12) arranged thereto, with nozzles or orifices of similar or dissimilar internal opening sizes.

17. The method according to any of claims 12-16, characterized in that the method further comprises:
- providing the string (4) with inserts (12) of identical external size and shape.

18. The method according to any of claims 14-17, characterized in that the method further comprises:
- extending the downstream side of said housing (36, 42, 86) axially and past said collar (34, 90), the extension of the housing (36, 42, 86) thereby forming a through-going and annular fluid collision chamber (48, 100) within which the injection fluid is subjected to a pressure-reducing energy loss.

19. The method according to claim 18, characterized in that the method further comprises:

- disposing a flow-through grid plate or perforated plate (50) of erosion-resistant material in said fluid collision chamber (48, 100).

20. The method according to any of claims 14-19, characterized in that the method further comprises:

- connecting the downstream side of the housing (36, 42, 54, 86) to a sand screen (44, 98).

21. A well injection string (4) for injection of a fluid into at least one reservoir (6) intersected by the string (4), in which at least a part of the injection string (4) includes at least one fluid outflow zone provided with one or more through-going pipe wall openings (28) located opposite the reservoir (6) when placed therein, and in which at least one pressure-loss-promoting flow control device is provided to at least one of said pipe wall openings (28) in the injection string (4), the flow control device controlling the injection fluid outflow rate therethrough and onwards into the reservoir (6) when placed therein, characterized in that the flow control device comprises an annular collar (56) provided with at least one axially through-going bore (58); wherein the collar (56) is disposed pressure-sealingly around the injection string (4) so as to project outwardly therefrom; and wherein the collar (56) also is disposed pressure-sealingly against an external and removable housing (54) pressure-sealingly enclosing said at least one pipe wall opening (28) in the injection string (4), thereby providing a through-going flow channel (38)

between the collar (56) and the at least one pipe wall opening (28).

22. The well injection string (4) according to claim 21, characterized in that two or more collars (56) are connected in series when placing two or more flow control devices within one fluid outflow zone along the injection string (4).
23. The well injection string (4) according to claim 21 or 22, characterized in that a collar (56) having two or more axial bores (58), is provided with bores (58) of similar or dissimilar diameters.
24. The well injection string (4) according to claim 21, 22 or 23, characterized in that at least one bore (58) is provided with a sealing plug.
25. The well injection string (4) according to any of claims 21-24, characterized in that the collar (56) is removably, pivotally or adjustably disposed around the injection string (4).
26. The well injection string (4) according to any of claims 21-25, characterized in that said housing (54), or a cover provided thereto, is removably disposed around the injection string (4).
27. The well injection string (4) according to any of claims 21-26, characterized in that the downstream side of the housing (54) is connected to a sand screen (44).

28. A method of controlling an injection fluid outflow rate from at least one fluid outflow zone of a well injection string (4) intersecting at least one reservoir (6), the at least one fluid outflow zone being provided with one or more through-going pipe wall openings (28) located opposite the reservoir (6) when placed therein, said method being initiated by injecting said fluid from surface via the injection string (4) and then through at least one pressure-loss-promoting flow control device provided to at least one of said pipe wall openings (28) in the injection string (4), after which the injection fluid flows onwards into the surrounding reservoir (6), c h a r - a c t e r i z e d i n that the method further comprises:

- using an annular collar (56) provided with at least one axially through-going bore (58) as a flow control device;
- disposing the collar (56) pressure-sealingly around the injection string (4) so as to project outwardly therefrom; and
- disposing the collar (56) pressure-sealingly against an external and removable housing (54) pressure-sealingly enclosing said at least one pipe wall opening (28) in the injection string (4), thereby providing a through-going flow channel (38) between the collar (56) and the at least one pipe wall opening (28).

29. The method according to claim 28, c h a r a c t e r - i z e d i n that the method further comprises:

- connecting two or more collars (56) in series when placing two or more flow control devices within one fluid outflow zone along the injection string (4).

30. The method according to claim 28 or 29, characterized in that the method further comprises:
- providing a collar (56) having two or more axial bores (58), with bores (58) of similar or dissimilar diameters.

5 31. The method according to claim 28, 29 or 30, characterized in that the method further comprises:
- providing at least one bore (58) with a sealing plug.

10 32. The method according to any of claims 28-31, characterized in that the method further comprises:
- disposing the collar (56) removably, pivotally or adjustably around the injection string (4).

15 33. The method according to any of claims 28-32, characterized in that the method further comprises:
- removably disposing said housing (54), or a cover provided thereto, around the injection string (4).

34. The method according to any of claims 28-33, characterized in that the method further comprises:
- connecting the downstream side of the housing (54) to a sand screen (44).

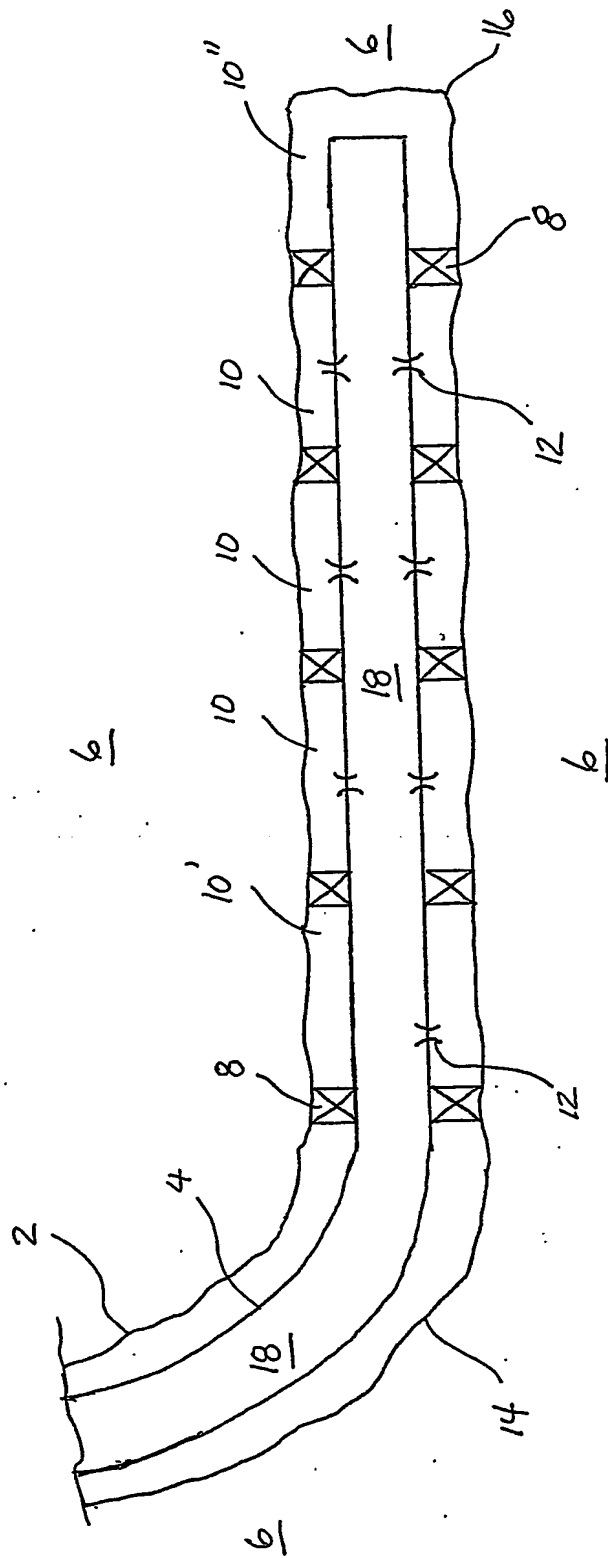


Fig. 1

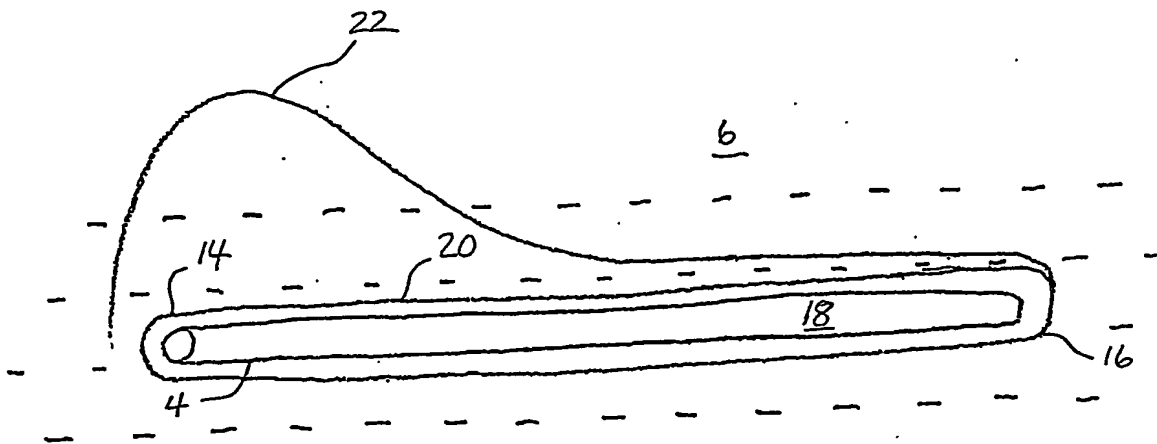


Fig. 2

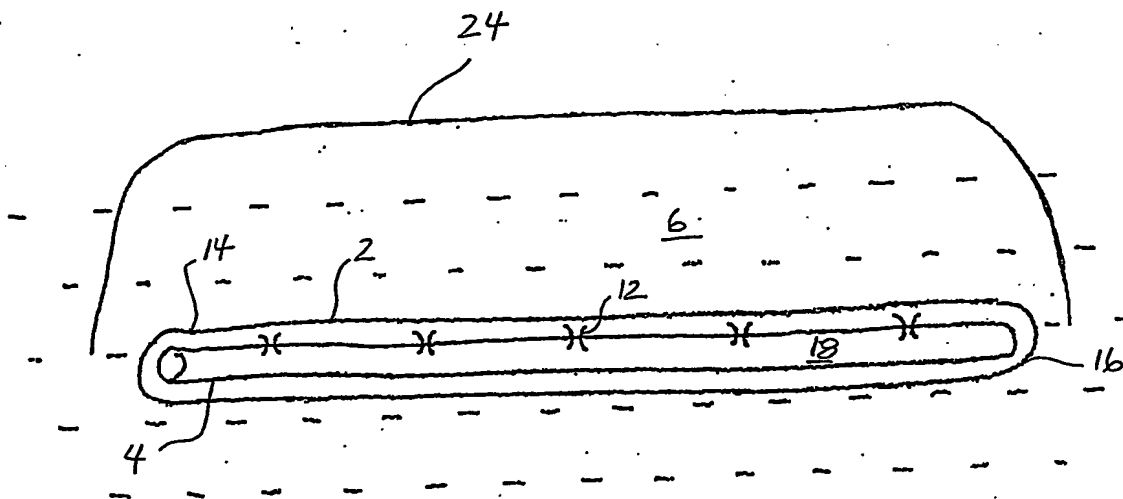


Fig. 3

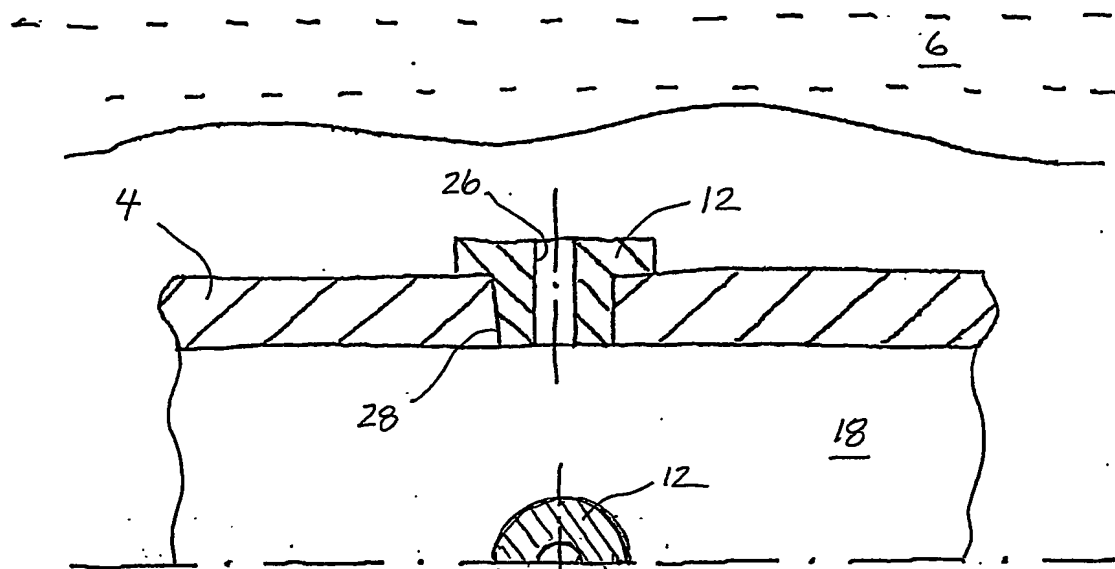


Fig. 4

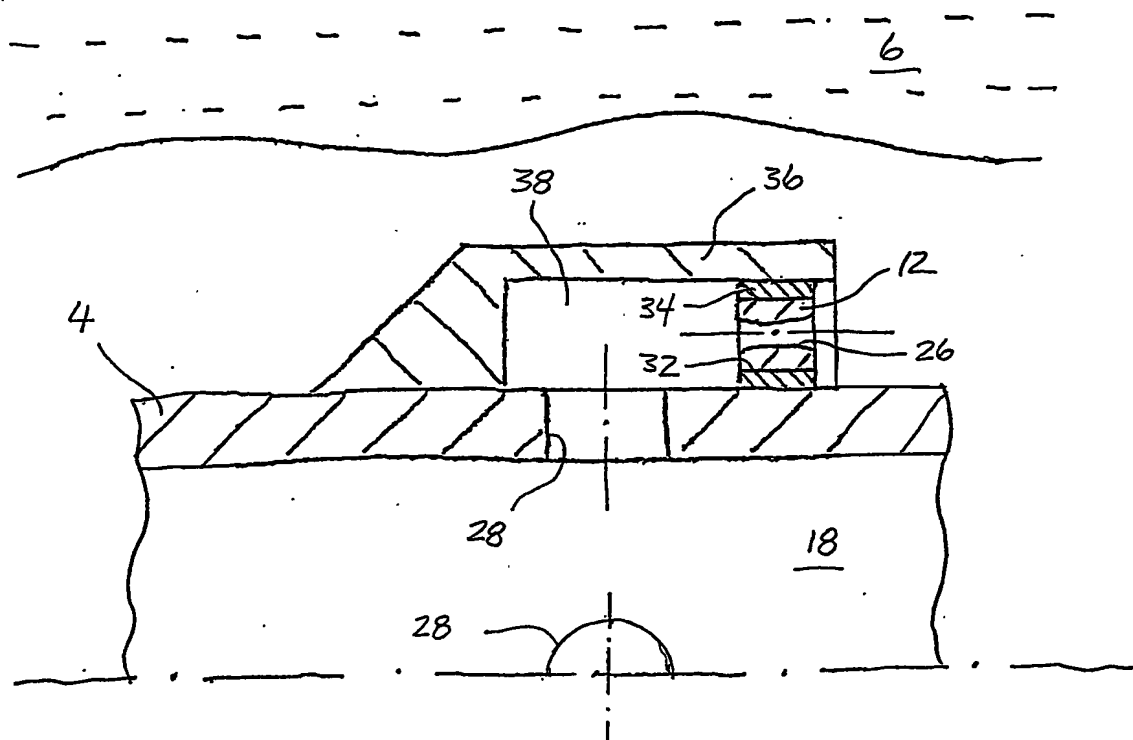


Fig. 5

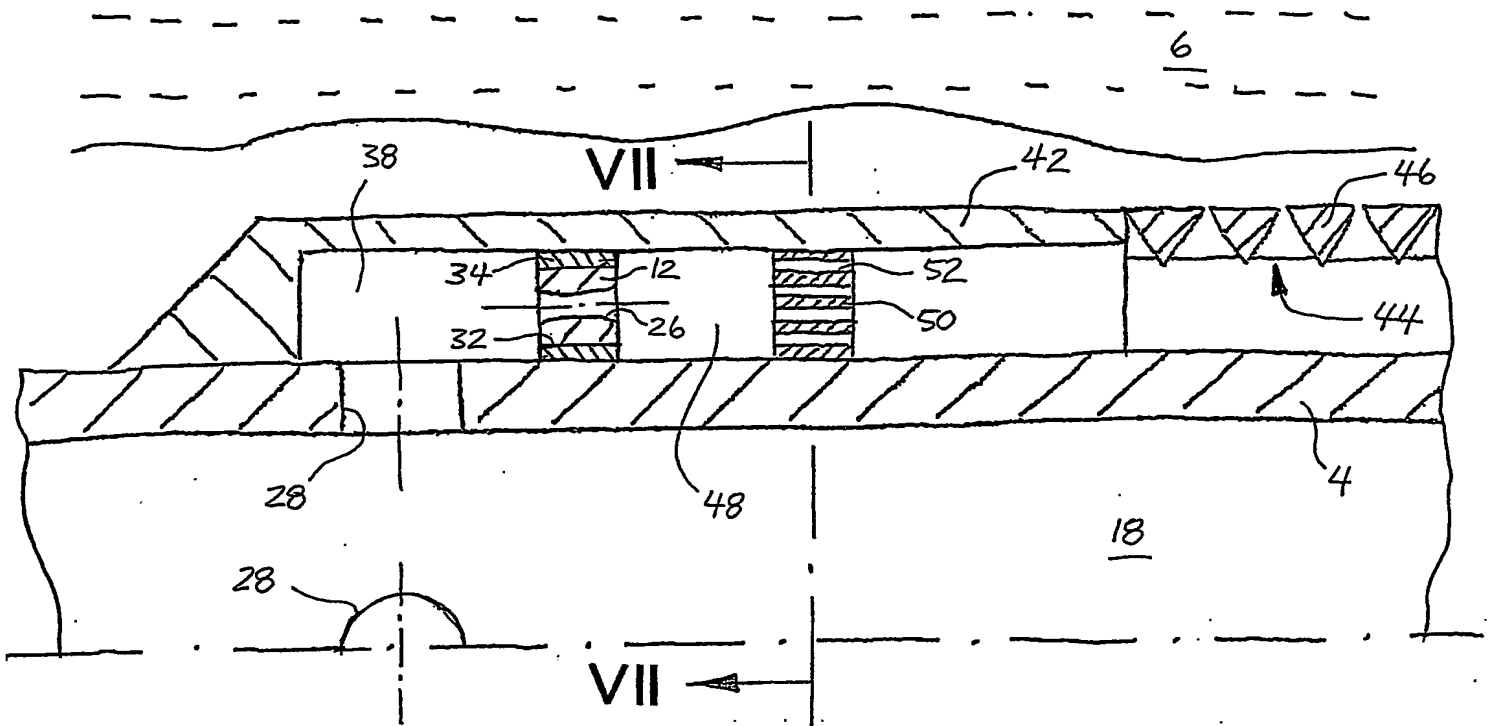


Fig. 6

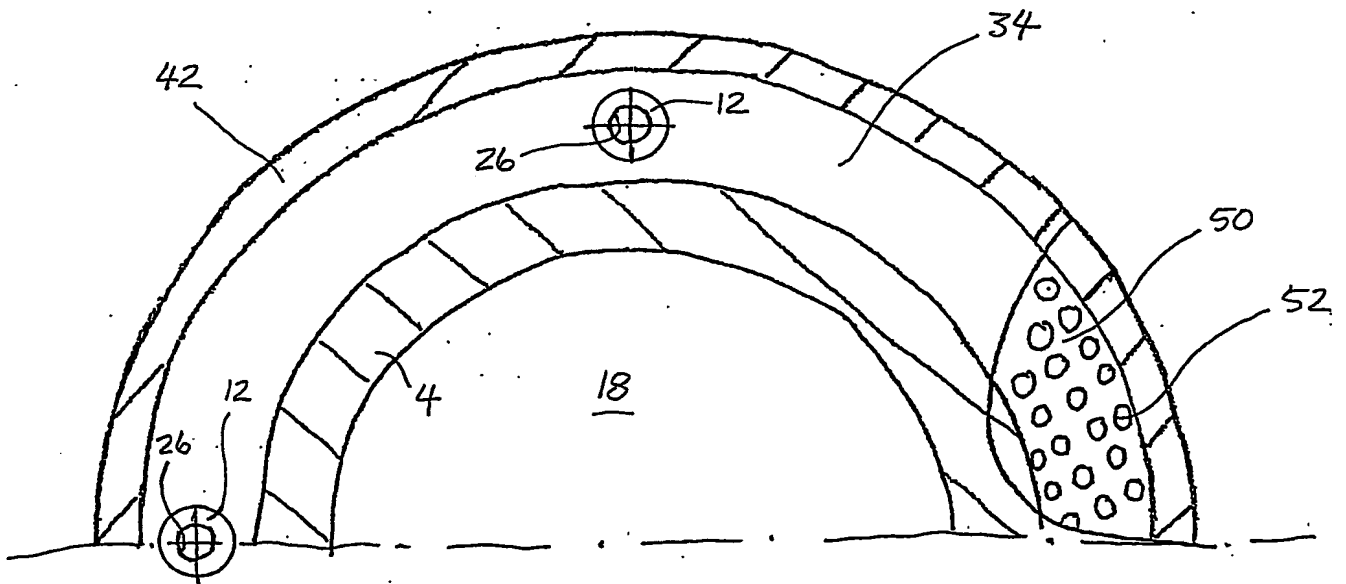


Fig. 7

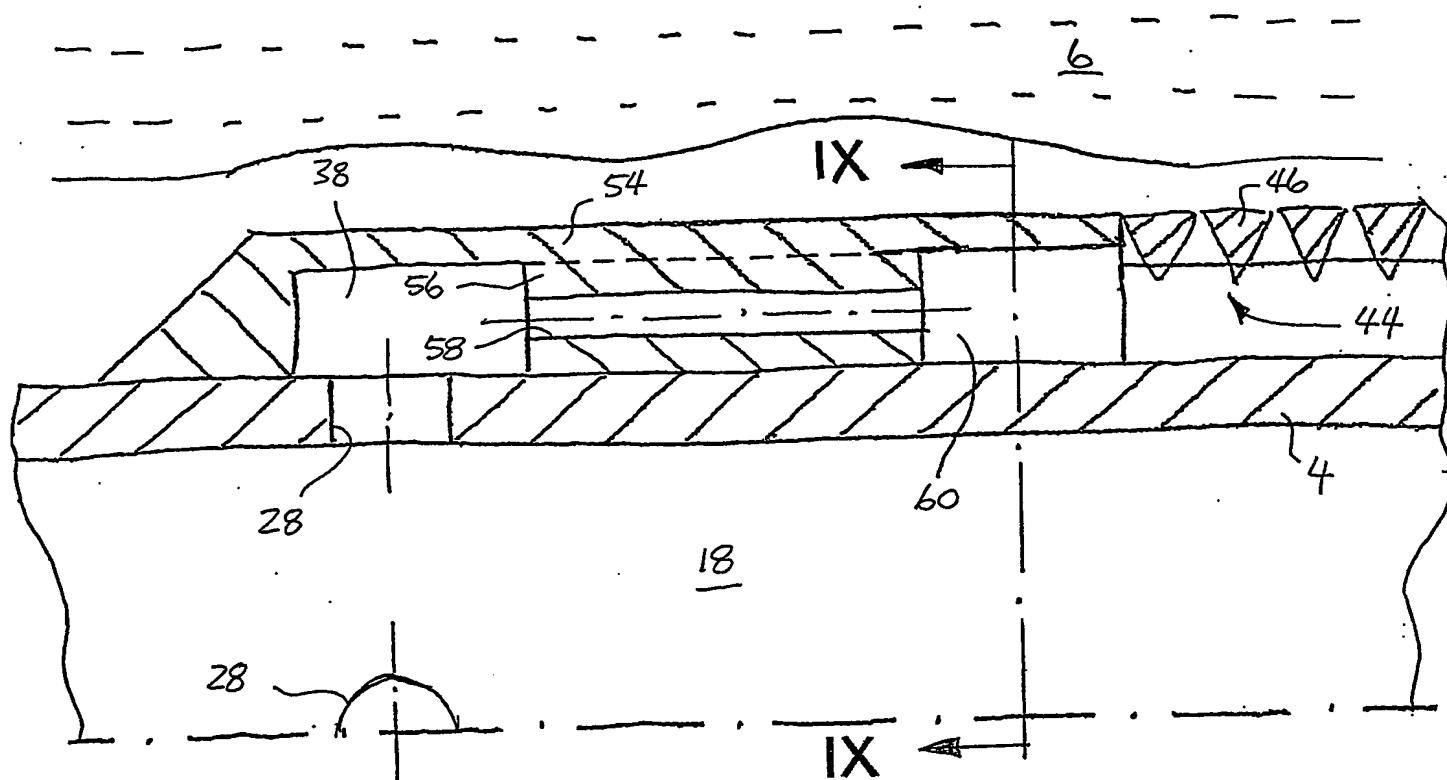


Fig. 8

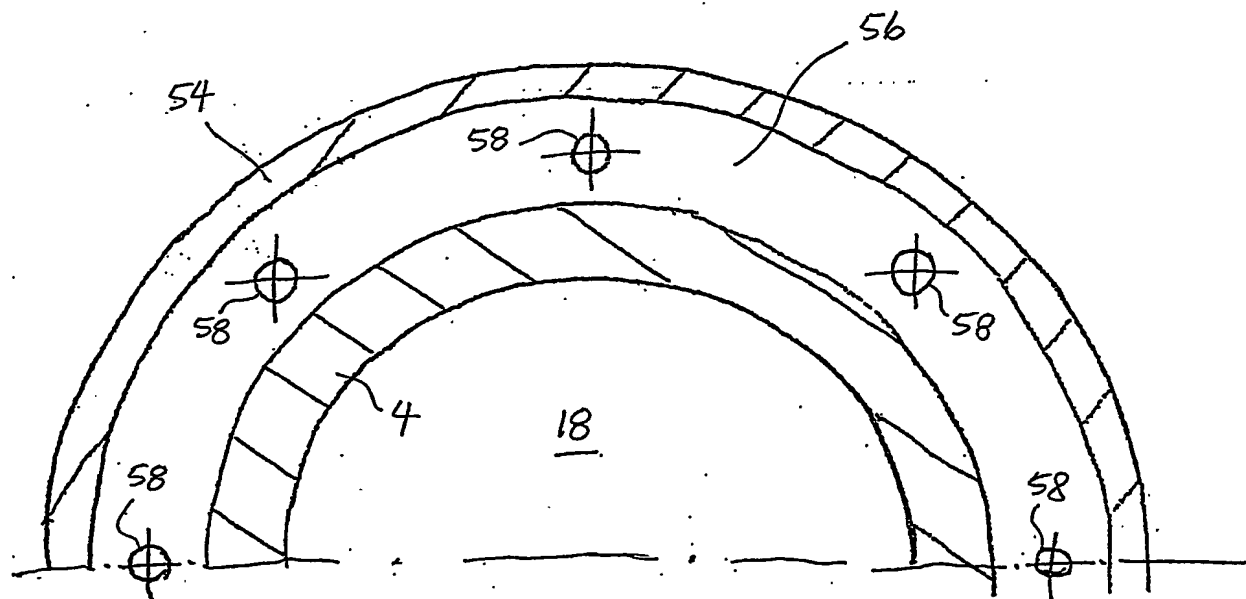


Fig. 9



AMENDED SHEET

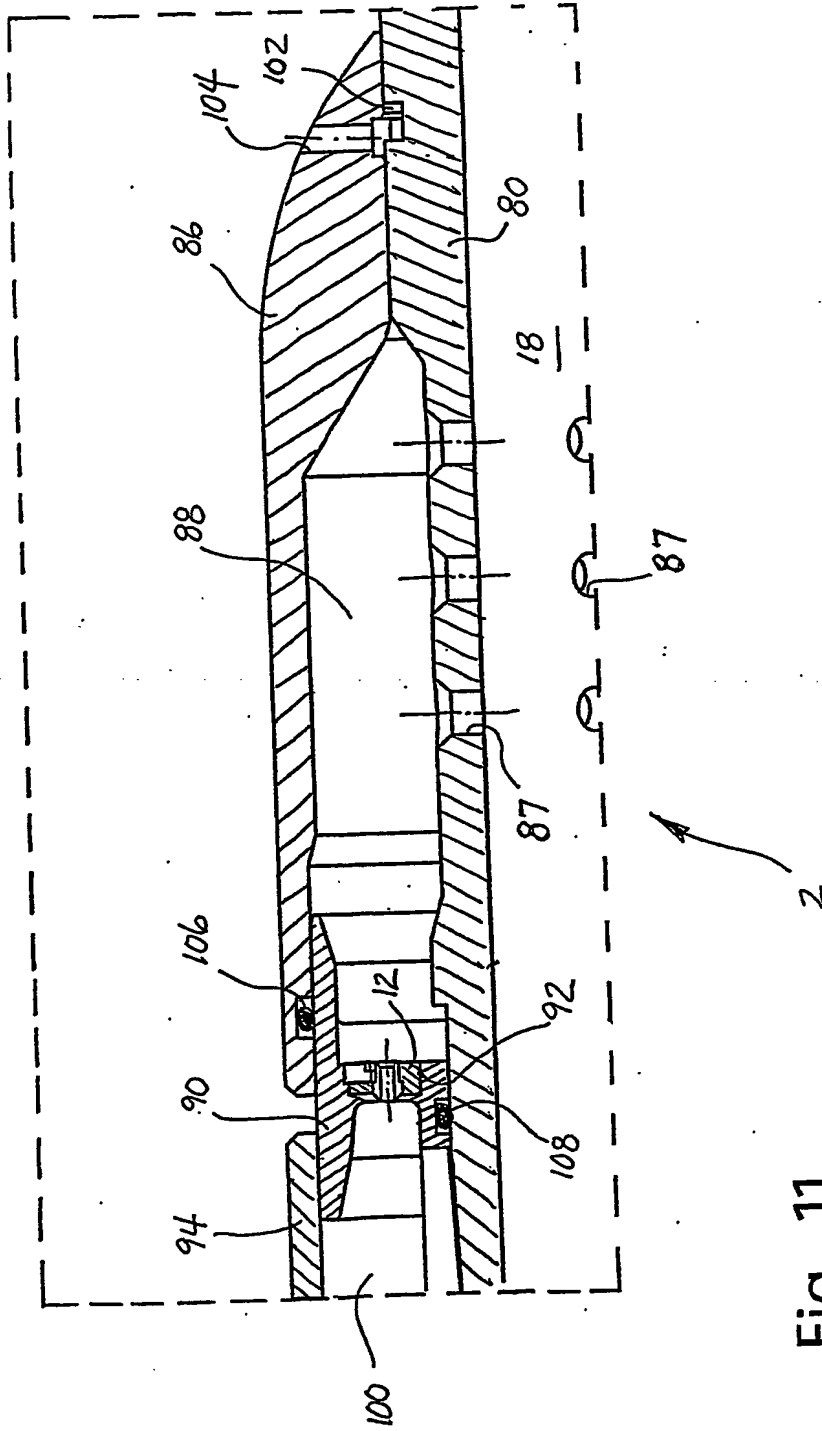


Fig. 11

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